

QUARTERLY PROGRESS REPORT

DRD 875MA-003

October 2002 – December 2002

**Marshall Space Flight Center
Safety and Mission Assurance Mission Services Contract
NAS8-00179**

Approved:



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1.0 INTRODUCTION

Hernandez Engineering, Inc. (HEI) successfully performed all required activities and tasks, as described in this report, in fulfillment of their Safety and Mission Assurance (S&MA) Mission Services Contract (NAS8-00179) with NASA's Marshall Space Flight Center (MSFC). This report covers a three-month period of the contract's first quarter of the second option year: October 2002 through December 2002.

2.0 GENERAL MANAGEMENT

2.1 Data Requirements

The first quarter of the second option year of the S&MA Mission Services contract was successfully completed on December 22, 2002. All Data Requirements (DR) Documents were submitted on or ahead of schedule throughout the quarter. They included DRD 875CD-001 On-Site Employee Location Listing; DRD 875MA-002 Financial Management Reports; DRD 875MA-003 Progress Reports (Monthly/Quarterly); DRD 875MA-006 Operations Plan, Problem Assessment Center (PAC); DRD 875MA-007 Quarterly Open Problems List; DRD 875MA-008 Monthly Newly Opened/Closed Problem Summary; DRD 875SA-002 Mishap and Safety Statistics Reports; and Quarterly Safety Performance Evaluation.

2.2 Personnel Status

(b) (4)

3.0 BUSINESS MANAGEMENT

We have experienced no financial or business management problems during this period. We are working closely with NASA procurement during the continuing resolution to effectively transition into the new contract year. We attribute this to close attention to details, effective use of established controls designed to efficiently respond to program changes---both anticipated and unexpected---and the continuing support of our corporate financial group's dedicated efforts at controlling overhead expenses.

The contract continues to have a total cost underrun at the end of this period---see the December 2002 Monthly Financial Report, DRD 875MA-002, for specifics. Attachment 2, Man-Hours Expended, of this report contains a description, by major task, of the total man-hours expended this period. ☐

(b) (4)

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4.0 PERFORMANCE OF WORK AND USE OF FACILITIES AND EQUIPMENT

4.1 Safety

4.1.1 Industrial Safety (IS)

The Industrial Safety (IS) group performed eight OSHA compliance facility inspections and provided all required reports in a timely manner, this completing the CY02 inspections. IS developed and submitted the CY03 annual facilities inspections schedule for QS50 review and approval. Also, IS performed 563 construction site compliance inspections to monitor adherence to OSHA and MSFC safety standards and performed verification checks of OSHA facility violations reported closed by Building Managers in 85 facilities. All facility safety violations were documented in the HAZTRAK databases in order to assure MSFC's compliance with OSHA, NASA, and other consensus code requirements.

Among other activities, IS: (1) updated one facility fire evacuation plan; (2) participated in two pre-construction conferences; (3) performed eight final safety inspections of facilities under renovation or construction; (4) reviewed 64 sets of facility design drawings for compliance with OSHA and consensus codes; (5) performed 53 fire drills; (6) taught two S&MA training classes for critical lift monitors and a pilot class for conducting monthly supervisor safety visits; and (7) assisted QS50 develop and process, for web page posting, four safety bulletins and nine Shop Talk safety information topics.

IS provided (b) (4) to assist the SHE Communications and Training Teams and general communication of safety awareness to all MSFC employees. Assistance included: (1) wrote multiple safety articles for publication in the Marshall Star; (2) prepared and processed, for web page posting, the weekly SHE highlights and monthly SSWP safety focus topics; (3) prepared monthly SHE communications plans; (4) developed multiple innovative safety awareness communications materials; (5) assisted QS50 in developing and preparing material for the Center wide Slips, Trips, & Falls Awareness Campaign; (6) assisted QS50 preparing and planning the MSFC 23 October Safety Day; (7) prepared numerous letters of appreciation for the Center and S&MA Director's signature to outside speakers and MSFC employees for their support provided to Safety Day; and, (8) researched, analyzed, and developed MSFC accident facts for FY00 – FY02 in support of a planned Back Injury Awareness Campaign. IS initiated, completed or followed-up on more than a dozen hazard analyses. Examples included: (1) completed a "delta" facility safety assessment (SA) for the U. S. Army VORTEX Thrust Chamber; (2) continued to perform a SA for the high visibility Propulsion Research Laboratory (PRL), now under construction; (3) initiated SA for the SLI Composite Cryotank Subscale Tank Test at building 4499; (4) continued to process for approval responsible organization recommendations for hazard closures identified in numerous SA's; and, (5) reviewed the SA for the Safe Affordable Fission Engine (SAFE) Nine-Foot Vacuum Chamber.

IS continued to support the implementation of the NASA lifting standard by providing day-to-day advice and assistance to S&MA customers. In addition to updating the Operating Hazard Analysis (OHA) for the ISS Common Module Transportation and Move Operations at MSFC, IS: (1) served as the S&MA safety monitor for the ISS Common Module Move at MSFC, reportedly one of the last missions for the NASA Super Guppy; (2) supported QS50 regarding the request to process a NASA safety waiver for lifting devices at KSC-USA; (3) prepared and processed the MSFC crane certification package for overhead crane 4493-001; (4) participated in the Gravity Probe-B Cart Design review and planning for the Transportation and Handling of the Gravity Probe B in California – will require an OHA and site safety monitoring; and, (5) administered hands-on proficiency examinations to two overhead-crane/hoist operators in support of the MSFC Personnel Certification Program.

As a continued significant strength, IS continued to provide (b) (4) to the MSFC Test areas. Examples of support included: (1) review and approved numerous operating procedures, such as for the liquid hydrogen transfer at Test Stand 116; (2) supported TD by preparing a general safety briefing for visitors to the test areas; (3) represented QS50 at numerous test area related meetings such as planning for the new test area access control system and a table top meeting with TD to address/review a new Test Project Process; and, (4) provided daily support to test engineers and S&MA personnel on technical issues to include performing numerous test procedure reviews.

4.1.2 System Safety Engineering

Payload Safety Engineering completed, reviewed, and updated 14 Safety Data Packages. These were: Node 2 Phase III Ground Safety Data Package (SDP), Node 3 Phase II Flight Safety Data Package (SDP), Biotechnology Carriers (BIC) reflight SDP, Environmental Control and Life Support Systems (ECLSS) hazards for Node 3 Phase II Flight, Phase II Ground Safety Data Package for DELTA-L, Phase III Flight Safety Data Package for DELTA-L, Zeolite Crystal Growth (ZCG) autoclaves, Glovebox Integrated Microgravity Isolation Technology (g-LIMIT) delta Phase III Flight Safety Data Package, Window

Observational Research Facility (WORF) Phase III Flight SDP, MSG Integrated Flight Safety Data Package for ULF-1, ProSED's MSPSP, Mechanics of Granular Materials (MGM) Phase III Flight SDP, Express ReFlight Packages for ULF-1 and 12A, ULF-1/STS-114 MPLM/Orbiter ReFlight Assessment package.

The Node 2 Phase III Ground Safety Data Package was submitted and presented successfully to the GSRP. The g-LIMIT delta Phase III Flight and Ground SDPs were successfully presented to the Payload Safety Review Panel (PSRP) & Ground Safety Review Panel (GSRP).

System Safety Engineering updated the previously developed Product Assurance Process for the Kistler Reusable Launch Vehicle (RLV) in support of Space Launch Initiative (SLI) and updated the subsequent Design Requirements Deliverables (DRD's) which include Safety, Reliability and Maintainability, Risk Management, Quality Assurance and Verifications. System Safety provided analysis, evaluation, presentation support for critical operational issues such as the, SRB Ethylene Propylene Diene Monomer (EPDM) rubber debond investigation, and the External Tank (ET) Thin Stringer Investigation.

System Safety Engineering provided Launch Support for the following projects at the Huntsville Operation Support Center (HOSC) for External Tank-115 STS-112, External Tank-116 STS-113, Solid Rocket Booster STS-112 and STS-113, Space Shuttle Main Engine (SSME) STS-112 and STS-113.

Verification Tracking Logs (VTLs) were initiated, completed, or updated for the Glovebox Integrated Microgravity Isolation Technology (gLimit), BTF and 11-A integrations of the Microgravity Science Glovebox (MSG), Propulsive Small Expendable Deployer System (ProSEDS), Protein Crystal Growth Single Locker Thermal Enclosure (PCG STES), Zeolite Crystal Growth (ZCG) autoclaves, Oxygen Generator Assembly (OGA), Environmental Control and Life Support Systems (ECLSS), Node 3, Mechanics of Granular Materials (MGM), Delta L, Thermal Enclosure System (TES) and the MPLM/Orbiter (Integrated) for Flight UF-2/STS-111, Node 2 was aggressively worked to facilitate a pre-February 2003 VTL closure.

System Safety Engineering initiated, completed, or updated Preliminary Hazard Analyses/Hazard Analysis to include Preliminary Hazard Reports (PHA's) for, Oxygen Generator Assembly (OGA), X-37, Co-Optimized Booster for ReUsable Applications (COBRA) Power Duct Design, Glast Burst Monitor (GBM), Protein Crystal Growth Single Locker Thermal Enclosure (PCG STES), Space Shuttle Main Engine (SSME) Ground Support Equipment (GSE) Hazard Analysis (HA), High Pressure Oxidizer Turbopump (HPOTP) Sub-System Hazard Analysis (HA), Solid Rocket Booster (SRB) element Hazard Analysis (HA), Reusable Solid Rocket Motor (RSRM) element Hazard Analysis (HA) and External Tank (ET) element Hazard Analysis (HA).

System Safety Engineering initiated, completed, or updated Fault Tree Analysis for the following Projects: MGM Load Cell Anomaly, Propulsive Small Expendable Deployer System (ProSEDS), Delta L, X-37, Hydrogen Test Facility Vent Fire Investigation and Observable Protein Crystal Growth Apparatus (OPCGA).

System Safety Engineering provided analysis/evaluation for the Pre-Ship Review/Pre-Flight Readiness Review (Pre-FRR)/Flight Readiness Review (FRR) on Belgian Taxi Flight (BTF) integration of MSG, Delta-L integration review, Bio Technology Carrier (BIC), Mechanics of Granular Materials (MGM), Glovebox Integrated Microgravity Isolation Technology (g-Limit) and Enhance Gaseous Nitrogen Dewar (EGN)

System Safety Engineering provided analysis/evaluation for the following: Shuttle System Safety Review Panels (SSRPs); STS-112 Pre Flight Assessment (PFA), STS-112 Program Mission Management

Team (PMMT) tag up, STS-113 PMMT tag up, Preliminary Assessment Reviews (PAR); Space Shuttle Main Engine (SSME) STS-112, STS-113 and STS-107 Element Assessment Review (EAR).

System Safety Engineering reviewed the Range and Ground Safety requirements and revised S&MA Plans for the Co-Optimized Booster for ReUsable Applications (COBRA), RS-83, Second Generation Reusable Launch Vehicle (2NDGRLV), Nuclear Space Initiative (NSI) Jovian Moon Tour (JMT) and Glast Burst Monitor (GBM).

System Safety Engineering developed generic data and hardware requirements and decision flowpaths to develop primary levels of sample containment for material science experiments.

System Safety provided analysis/evaluation for Design Reviews for the following projects; Co-Optimized Booster for ReUsable Applications (COBRA), Nuclear Space Initiative (NSI) Jovian Moon Tour (JMT), Oxygen Generator Assembly (OGA), Environmental Control and Life Support Systems (ECLSS), Urine Processor Assembly (UPA) and the Water Processor Assembly (WPA).

For S&MA System Safety continued the Shuttle elements SSME, ET, SRB, and RSRM work/review of Major Milestone Reviews, (Acceptance Reviews, Mate Review, Pre-Launch Assessment Review, Flight Readiness Reviews, and Pre-Flight Assessment), Chief Engineering Review Board, Engineering Change Packages, Document Change Notices, Record Change Notices, Discrepancy Reports, Action Items, Change Requests, Manufacturing Process Change Proposed, Plant's Operating Work Centers, Post-flight Reviews, Launch Support, and day-to-day flight and test issues. System Safety continues to evaluate Unsatisfactory Condition Reports (UCRs), and Problem Reports (PRs), as required for shuttle support programs, as well as review changes for impacts to safety.

4.2 Reliability

4.2.1 Reliability & Maintainability Engineering (R&ME)

In support of the Advanced Projects Assurance Department, R&ME continued providing R&M discipline support to the 2nd Generation Reusable Launch Vehicle (2GRLV) program, including review of program documentation to ensure that R&M requirements are correctly specified. R&ME reviewed and provided comments on the Demonstration of Autonomous Rendezvous Technology (DART) program specifications and orbital debris analysis, the Integrated Systems Test of an Airbreathing Rocket (ISTAR) Reliability Program Plan, RS-84 statement of work and data requirement descriptions, and numerous other 2GRLV technical documentation. R&ME participated in the DART critical design review and coordinated several reliability related issues with Orbital Sciences. R&ME is also actively involved with the Advanced Electric Propulsion program and is providing input to several trade studies regarding various vehicle design configurations, and is currently researching information related to space debris and radiation dose limits for crews and equipment.

In support of the Shuttle Assurance Department, significant R&ME activities included participation in the flight readiness review and launch support activities for STS-112, STS-113, and STS-107 as well as active participation in various anomaly resolution teams. Additionally, R&M continues to support ongoing effort related to Shuttle Upgrades, including active participation in the ET friction stir weld process development and qualification, as well as in the qualification process for the SRB Command Receiver Decoder and Altitude Switch Assembly. R&M also participated in the SSME Advanced Health Monitoring System (AHMS) Phase 2B Preliminary Design Review.

In support of the Cargo Assurance Department, R&M continued development and program coordination of verification closure documentation to support the Node 2 requirements verification activities. All Node 2 R&M requirements are currently on track for closure in advance of the Node 2 acceptance review

activities. R&ME continued development of the Node 3 FMEA/CIL and provided the FMEA data to Alenia to support development of the Failure Detection, Isolation, and Recovery (FDIR) analysis. R&ME updated the FMEA/CIL for the Regenerative ECLSS Oxygen Generation Subsystem to incorporate RIDs from the ECLSS Integrated Rack CDR and distributed it for internal review by the ECLSS team. R&ME also began development of a FMEA for the MPLM shell heater programmable thermostats that are being developed in house by MSFC.

R&ME Engineering completed development of and conducted a "Failure Modes and Effects Analysis/Critical Items List (FMEA/CIL) Basics" training course. The intent of the training course was to provide an overview of the FMEA/CIL process in order to familiarize S&MA personnel with the proper implementation of FMEA/CIL on MSFC programs and projects.

4.2.2 Problem Assessment Center (PAC) Operations

HEI's PAC personnel processed and coordinated disposition of problem reports, supported launch milestones, coordinated the MSFC Problem Assessment System, and operated the Corrective Action System (CAS). The PAC received and entered 15 new problem reports (PRs) into MSFC's Problem Reporting and Corrective Action (PRACA) System, coordinated MSFC interim closure of 36 PRs, received 10 prime contractor closure recommendations, supported MSFC full closure of 15 PRs (including 4 old IUS problems), coordinated non-problem closure of zero problems, and performed 201 individual PR database updates and reviews. In cooperation with HEI Information Management, the PAC coordinated re-establishment of direct problem transfer and loading of SSME problem updates from the prime contractor. PAC conducted 9 SSME problem review boards (PRBs) resulting in the disposition of 31 of 32 problem reports presented and issued PRB minutes covering the previous six months of Board meeting activities. The PAC generated or updated trends for all SSME, RSRM, and SRB problems submitted as newly opened or for closure. PAC also generated and distributed monthly problem bubble trend risk charts including active problems status, ages, and raw and moving average new problems over the last 13 months.

The PAC supported 10 pre-launch milestones for STS-112, STS-113 and STS-107 in addition to Shuttle Project PFAs, 4 launch attempts and 2 successful launches. Launch preparation included expedited disposition of 3 SSME and 1 ET problem just days before STS-113's scheduled launch. PAC also provided various data histories in support of launch problem analysis, including STS-112 In-Flight Anomalies and hold-down post anomaly and STS-113 ET longeron cracks, ET ullage pressure, SSME MLP heaters, ET bipod ramp, and SSME cold wall nozzle leak. Furthermore, PAC participated in the contingency simulation conducted in conjunction with the STS-113 FRR

In problem system coordination, the PAC conducted 2 SRB Problem Assessment System (PAS) status reviews for the SRB Chief Engineer performed an on-site review of the SSME carbon seal manufacturer Speedring/Axsys, and performed a problem processing compliance survey of Rocketdyne in association with the NEQA review.

The PAC provided various problem data in support of NASA and MSFC analyses. Regular activities included providing daily KSC PRACA shuttle problem summaries, daily MSFC PRACA open-against-next-mission summaries, daily KSC Resident Office reports, monthly HEDS new shuttle problem charts, monthly newly opened/closed problem summaries, and quarterly Open Problems List (OPL). Special activities included developing charts and supporting recommendations regarding the S&MA Employee Survey for S&MA; developing a format and providing the chart illustrating the number of deferrals and age of active SSME UCRs for the SSME Project; drafting the flight rationale 1-page summary on the SSME nozzle cold wall leak for the STS-107 PAR; and developing and presenting responses to a series of survey questions from the Shuttle Certification of Flight Readiness (CoFR) Independent Assessment (IA) regarding MSFC PRACA processing.

In implementation and operation of the MSFC CAS, PAC received 50 potential CAS reports, screened 50 draft Recurrence Control Action Requests (RCARs), and initiated 2 new RCARs. PAC received 8 responses from laboratory points of contact with either disposition rationale or response extension requests. PAC coordinated Corrective Action Board review of 3 RCARs (resulting in full closure of 2 of them) and a meeting to resolve issues from an RCAR regarding Certification of Qualification (CoQ) processing. PAC also provided open RCAR status reports and discussed them at the Marshall Management System (MMS) Implementation Team meeting, issued monthly RCAR status and delinquent response reports, presented monthly metric charts of RCAR activities and statuses at the MMS Implementation Team, and were audited on our operation of the CAS by NQA during the 10th MSFC Surveillance Audit (with no findings being issued in our area). In addition, we initiated, monitored, and verified URL reference correction of the data base entry panel and on-line electronic storage of the Customer Feedback Forms, and performed annual review of 5 MMS documents, that resulted in submittal of minor updates to four.

4.2.3 ALERT Program

HEI's ALERT support included both regular and special activities as HEI coordinated MSFC ALERT processing. HEI received and distributed 22 ALERT announcements for MSFC review (including 1 MSFC-initiated problem advisory) and obtained 1,869 responses from MSFC project, contractor, and laboratory contacts. HEI reviewed 39 and approved 38 accounts via the TPS security for access to the MSFC ALERT Notification, Status, and Response Data System. HEI held an ALERTs awareness booth at the annual Safety Day, conducted a meeting where HEI led discussion of ALERT processing with the S&MA ALERT actionees, and discussed and obtained approval of a new form to document QS20 ALERT release evaluation during launch-imminent mode, generated monthly Open, Delinquent ALERT response tabulations and provided them to S&MA and/or Directorate single points-of-contact responsible for open ALERT reduction – continuing to work with S&MA and Project/Directorate personnel to identify and eliminate inactive programs from ALERT processing requirements. PAC personnel also drafted and, after QS40 approval, submitted the annual GIDEP Utilization Report for MSFC. HEI uploaded the MSFC ALERT processing procedure and contract template to the NASA ALERT PBMA application, obtained training for a back-up support person at the annual GIDEP Clinic, and solicited candidates from MSFC ALERT contractor contacts for GIDEP Industry Advisory Group (IAG) membership.

4.3 Quality

Space Transportation

External Tank (ET) Quality Engineering participated in three investigations during this reporting period. ET Quality engineering assessed an inspection and clearance plan for ET intertank stringers due to low material thickness. Quality engineering also assessed investigation actions as a result of excess foam loss on the -Y bipod ramp detected during post separation photo review of STS-112. Finally, ET Quality engineering assessed a nonconforming condition due to an ET/Orbiter attach ball fitting violation of the maximum ball height allowable by the Interface Control Document (ICD). In addition, Quality Engineering reviewed an engineering process specification that established the requirements for Friction Stir Butt Welds and documented exceptions in the specification and reviewed three nonconformances on Composite Nose Cone bracket assemblies generated because of supplier discrepancies identified at receiving acceptance.

Solid Rocket Booster (SRB) Quality Engineering represented MSFC S&MA on four Phase III review teams for Pyrotechnic hardware and Booster Separation Motors during this reporting period. These teams reviewed manufacturing process paper, acceptance test results and hardware inspections. SRB Quality engineering was designated as a team member on the Phase II NASA Engineering and Quality Audit

(NEQA) Team at United Space Alliance. SRB Quality identified four Category II findings and two observations during the audit of the Booster Separation Motor Installation Process. SRB Quality engineering evaluated contractor submitted Engineering Change Proposals, Certificates of Qualification, and Failure Modes and Effect Analysis/Critical Items List updates.

Space Shuttle Main Engine (SSME) Quality Engineering coordinated efforts of the S&MA community across multiple centers to initiate a risk assessment associated with incorporating the Battleship flow liner simulator test article into the space shuttle main engine test program. Quality engineering inspected the test equipment and coupons used at the MSFC liquid hydrogen flow facility and provided digital pictures of the inspection to the S&MA risk assessment team. SSME Quality engineering was designated as a team member on the Phase II NASA Engineering and Quality Audit (NEQA) Team at United Space Alliance. SRB Quality inspected the turbo machinery/valve clean room for Foreign Object Debris (FOD) control issues identifying uncontrolled shop aids used in the assembly process and performed audits of the tool receiving and inspection process finding an uncontrolled desk instruction in use.

Reusable Solid Rocket Motor (RSRM) Quality Engineering was involved in four RSRM special issues. These included Chemlock Witness Panel failures, missing X-rays of RSRM hardware at Thiokol, Aft Exit Cone machining errors, and misidentification of pin retainer bands. Quality engineering also attended Introduction to Propulsion training at the University of Alabama at Huntsville, and MSFC Basic Quality and FMEA/CIL training. During the quarter RSRM Quality Engineering also developed a spreadsheet to track Thiokol quality corrective action reviews and performed along with Independent Assessment a gap analysis of quality requirements in NSTS 5300.4(1D2) versus AS9100 standard requirements.

Software Quality Assurance (SQA)

Software Quality Assurance (SQA) reviewed the Material Science Research Rack (MSRR-1) Software Requirements Specification (SRS) Revision B. Comments were provided and included references to requirements that had been listed as findings in a previous SRS audit due to inability to verify parameters by test. SQA monitored MSRR-1 pre-Combined Components Interface Testing (CCIT) 2 Software Functional Regression testing activities. Flight Software (FSW) Operational Increment (OI) 2.3, barring the discovery of any major problems that would compromise or diminish the quality of the product relative to satisfying CCIT2 objectives, FSW OI 2.3 will be released for CCIT2 activities scheduled for January 2003.

ISO

Quality Engineering has continued to play a key role to ensuring the maintenance of ISO 9001 at MSFC during this time period. Efforts have dealt with continuing implementation of the ISO 9001: 2000 revision, maintenance of documentation, internal quality audits, and planning and support for the NQA registrar audit, including acting as an escort, and follow-up and closure of corrective actions. Quality Engineering provided general ISO support, including documentation reviews and consulting support on internal audits, training, continual improvement, and other aspects of ISO 9001, to various MSFC Organizations. Quality Engineering provided support to the Marshall Quality Council, including providing status of NQA findings, participation in development of the agenda and various presentations, and keeping the minutes. Quality Engineering assisted with response to four Freedom to Manage suggestions.

Payloads

Quality Engineering (QE) performed an Independent Assessments for Glovebox Integrated Microgravity Isolation Technology (g-LIMIT), Biotechnology Carriers (BiC) and Mechanics of Granular Materials (MGM).

Quality Engineering performed Acceptance Data Packages reviews for Gravity Probe-B (GP-B), Materials Science Research Rack (MSRR), Quench Module Insert (QMI), and MGM. Quality Engineering conducted Quality System Reviews at the Naval Research Laboratory (NRL), the Smithsonian Astrophysical Observatory (SAO), and Lockheed Martin in support of the SOLAR-B Project. Quality Engineering performed Drawing Reviews, Procedure Reviews, Procurement Reviews, Statement of Work Reviews, and attended team meetings for MSRR, GP-B, SOLAR-B, MSG, TES, BiC, ProSEDS, Delta-L, OPCGA, TIPMPS, SHIVA, QMI, ELCSS, MGM, GBM, EGN, and EXPRESS Rack. Quality Engineering reviewed and provided closure for S&MA assigned verification items for ProSEDS and g-LIMIT. QE reviewed and provided comments to the Verification Plans for both TES and ECLSS. Quality Engineering supported failure investigations for MSG and SUBSA.

Inspection and Test

Quality Engineering revised the nondestructive Organizational Issuance for S&MA Quality Assurance. Quality Engineering reviewed and released procedures for the testing of the Laser Ignition system. Quality Engineering reviewed the Operational Instructions for the test of the ASA Qualification Unit and monitored pressure and thermal testing.

Quality Assurance continued to provide support in all MSFC test areas to MSFC test engineers and contract support personnel. The plasma arc facility, Test Stand (TS) 116, TS 300, TS 500, and the hot gas test facility are among the test areas supported by Quality Assurance. Test procedures and planning were reviewed to ensure that proper quality and test requirements are met on a day-to-day basis. Quality Assurance continued to perform receiving inspections and witnessing of assembly and testing for DELTA-L, PCG, g-LIMIT, PCAM, MSG, VCD, ProSEDS, UPA, MSRR, QMI, SUBSA, PFMI, InSPACE, MGM III, PCAM, and OGS.

4.4 Information Management (IM)

Information Management (IM) implemented two innovations during the quarter that significantly improved processes. The most visible contribution was the incorporation of the login module for the Supervisor Safety Web Page (SSWP) and Inventory of Hazardous Operations (IHOPs) applications into S&MA's integrated login module. The change significantly improved the interface for the 500+ users and reduced overhead activities required for maintaining the security structure. IM also developed functionality allowing entry and edit of inspection findings in electronic format through use of Personal Digital Assistants (PDAs). The electronic process also included development of a database for editing the findings on a pc; a program to transfer data to the database; and functionality to export the findings to a central database. The electronic process eliminates paper copies, improves time to closure of finding information, and improves data integrity by reducing additional chance of error through third-party data input.

Several applications were developed and deployed during the quarter. IM produced a web-based application for use by S&MA in monitoring travel-related information. The MSFC S&MA Office Team Survey was developed and deployed, and methods for reporting metric data were coordinated. Information from the survey will be used in the Strategic Planning process. IM also produced two Safety Health and Environmental (SHE) program surveys and modified SSWP and IHOPs for incorporation of the modules. Metrics modules were also provided in SSWP to allow managers' visibility of their organization's survey information and to report the number of No answers per question. Data from the surveys will be used to improve the SHE program at MSFC. The Space Flight Awareness application was rewritten to incorporate new requirements; improve interface with web pages that utilize the information; and update the development language to improve maintainability.

Numerous improvements to Industrial Safety applications were incorporated. IHOPs was modified to associate information by suborganization; allow checklist deletion; improve checklist functionality; and to revise metrics for FY03 data. In addition, the Checklist database was converted to MS SQL Server to improve response time. The Contractor database was modified to provide additional input and retrieval information and to calculate rates. Safety inspection finding reporting was improved by automation of a report of safety inspection findings by area. A Master Chart summarizing findings by status and organization was also automated and made available to MSFC personnel. Safety Search was modified to highlight finding types. The Safety Concerns Reporting System (SCRS) was modified to improve email notification, classification update capability, search and metrics. SSWP was revised to include Risk Assessment Codes (RAC) for findings, modify the Safety Topics page, and incorporate two user requests.

Other significant application modification activity included revision of the ALERTS application to update historical data, provide additional administrative functionality, provide new and improved reports, and improve login module functionality. Other applications modified include the As-Built Configuration Status System (ABCSS), MSFC's Marshall Management System (MMS) applications, and the Combined Federal Campaign and Safety Day sites. In addition, a report for use by the MSFC Medical Center in verifying personnel's contract information was also produced.

Other activities included support of centerwide data calls, security plan updates, migration of the development server, and resolution of a scanning problem.

4.5 Human Exploration and Development of Space (HEDS) Assurance

During this reporting period, the MSFC HEDS IA group continued to support a wide range of S&MA activities. One team member updated training material and taught a course on basic quality to S&MA personnel. Another team member provided training in Continuous Risk Management to ISTAR (Integrated System Test of Airbreathing Rocket) personnel. This training which included an extensive workshop resulted in a significant change/improvement in the CRM approach for the ISTAR project.

One team member participated in a review and rewrite exercise of NPG 7121.XX, Surveillance Planning on NASA Programs and Projects. This review, held at KSC, was chaired by a representative of the NASA Chief Engineer's office and was attended by Code QE and other NASA centers. A team member also participated in a meeting at KSC, chaired by Code QS personnel to discuss and develop methodology of accomplishing needed supplier surveillance and to evaluate a proposed new method of measuring and reporting a supplier risk rating.

IA continues to support various CODE Q initiatives through participation in the Quality Leadership Forum (QLF).

In addition to assessments performed for the major MSFC programs, one assessment was performed across the center in conjunction with SMO personnel. An assessment team, co-chaired by managers from S&MA and SMO, conducted interviews of randomly selected MSFC projects to evaluate the level of maturity of risk management implementation at MSFC, and to make recommendations for improvement.

MSFC HEI IA also participated in a Code Q hosted IA Summit meeting at NASA Headquarters to set the course for future Independent Assessment coordination and activity.

4.5.1 International Space Station (ISS) Independent Assurance

ISSP program evaluations/assessments performed or in process during this period included: MSFC ISS Payloads Compliance with SSP 50431, Gravity Probe B Gas Management Assembly (GMA), and the Payload Operations Integration Center (POIC).

4.5.2 Space Shuttle Independent Assurance

Space Shuttle element evaluations/assessments performed during this period included: Michoud Assembly Lifting Equipment Maintenance/Repair and Personnel Certification Process, Comparison of AS9100 and NSTS 5300.4 (1D-2), SSP CoFR process, and preparation and plan for Evaluation of Procurement Quality Control at Lockheed Martin Michoud.

4.5.3 Space Launch Initiative Independent Assurance

One team member provided extensive support to the SLI management team in the preparation of an SLI Risk Management Plan. This included a visit to JSC to review their Risk Management process on Space Station. Team members attended various SLI meetings and presentations

4.6 Project Assurance

Project Assurance Engineering was heavily involved in flight readiness activities and participated in all Shuttle Element S&MA Preflight Assessments and project flight readiness reviews. QE prepared 10 one-page summaries in support of flight readiness. PA also supported numerous shuttle element project reviews such as ET Shuttle Observation Camera Technical Interchange Meeting, Block II SSME Design Certification Review, HPFTP/AT Design Certification Review, Friction Stir Welding Review, RSRM Propellant Casting Process Review, and Booster Separation Motor Review.

Project Assurance Engineering continues to support Shuttle pyrotechnic device and booster separation motor procurement and flight certification. This involves review of pyrotechnic hardware design changes and supplier manufacturing, inspection and test documentation and pre-production and lot acceptance reviews.

Project Assurance Engineering provided technical support and assessments of Space Shuttle flight readiness for Pre-launch Assessment S&MA reviews and the Center Director's Technical Issues Briefing for STS-112 and STS-107. PAE provided support for the ET/SRB Mate Milestone Reviews, Orbiter Rollout Milestone Reviews, Pre-launch Assessment Reviews (PARs), Flight Readiness Review Tagup PARs, PMMT Tagup PARs and Technical Issues Briefings (TIB) to Center Director for STS-112 and STS-107.

Project Assurance Engineering and QS10 Management, met with S&MA representatives from the Consortium (Pratt & Whitney, Boeing/Rocketdyne and Aerojet) to address a request for relief from selected S&MA DRDs during the next 6 month option period. The Consortium's request for relief was in response to increased manpower costs associated with contractor staff reductions at each facility. QS10 agreed to grant temporary relief for the following deliverables: 1) Safety Program Plan Updates, 2) Quality Program Plan Updates, and 3) GIDEP (ALERTs). Relief from the Safety and Mishap Statistics Reporting DRD was denied as each contractor is legally bound to report such data. Both the Safety and Quality Program Plans had been reviewed and approved by Project Assurance and any changes anticipated during the next option period would be in the form of minor updates which would be captured in subsequent submittals. The GIDEP (ALERTs) DRD was not included in the original contract and, since the next option period schedule included neither hardware production nor testing, S&MA felt we could grant relief for the period with no significant impact to the program.

Project Assurance Engineering attended a Boeing presentation on Human Ratings possibility of the Delta IV. The discussion was a result of the SLI potential need to transfer crew to orbit on a Re-usable Launch vehicle (ELV), such as Delta, Arian, Atlas, etc. before the Re-usable Launch Vehicle is available. The presentation was encouraging in that the human rating needs are achievable and within a short period of time. In addition, PAE will travel to Boeing and Orbital Science Corporation to evaluate their design with emphasis on operational scenarios. These designs, or trends, are intended to increase the emphasis on operations, as required by SLI.

Project Assurance Engineering represented QS20 at the CDF Initiator Phase III Review held October 22-24, at Pacific Scientific, Chandler, AZ. The phase review team included representatives from MP41, United Space Alliance (USA) Engineering, and USA Quality Engineering. The team conducted hardware inspection, examined radiographic film, and reviewed manufacturing, test and inspection documentation for an accepted quantity of 203 each Lot ABL CDF Initiators.

SRB Project Assurance Engineering supported QS20 during the meeting held to review the NEQA Phase I audit results as presented by United Space Alliance (USA) and continue the planning for our participation in the Phase II activity scheduled for the week of November 18. The co-chairmen reiterated the purpose and scope of the audit. PAE assisted our NEQA team lead in determining the documentation required to support the review.

Project Assurance Engineering participated in the investigation into potential FOD introduced into BSM's that could become a source of debris impact to the Orbiter/External Tank. The investigation was instrumental in isolating most likely cause and determining flight rationale for STS-113 and subsequent missions. PAE assisted in the development of the presentation for the STS-113 Pre-launch Acceptance Review.

Project Assurance Engineering supported the STS-113 FRR Tagup PAR which was conducted via teleconference October 29, 2002. Discussion items presented by MSFC S&MA included the External Tank (ET) Intertank Stringer Issue and quality inspection data. STS 112/ET-115 Bipod Ramp Foam Loss. Solid Rocket Booster (SRB) presented alleged vendor falsification of heat treat. The PMMT Tagup was conducted November 6, 2002. The External Tank Assurance team presented ET/Orbiter Attach Ball Fitting and SRB presented SRB Booster Separation Motors (BSM) Possible Foreign Object Contamination. For both reviews HEI coordinated presentation material, transmitted presentation material to HQ, provided electronic presentation of material and provided back up support during the review.

Project Assurance Engineering supported the STS-113 Technical Issues Briefing (TIB) to the Center Director that was held on October 28, 2002. The ET Project Office presented, LO2 Feedline Foam Repair, Under Thickness Intertank Stringers and STS112/ET115 Bipod Ramp Foam Loss. The SRB Project Office presented a status of the STS-112 Hold Down Post Pyro Issue. The RSRM Project Office gave a verbal status of X-ray inspection of Loaded Segments. The Flight Directorate Project Office and the Science Directorate each presented a current status of their projects and payloads. Project Assurance coordinated presentation material, prepared S&MA presentation and provided computer support during the TIB.

Project Assurance Engineering provided Level A support for the launch of STS-113. PAE supported HOSC Safety and the each of the Shuttle Assurance Safety consoles for 3 attempts. The first attempt November 10th was scrubbed due to oxygen levels in the orbiter's mid body. The 2nd attempt on November 23rd was scrubbed due to inclement weather at the Transoceanic Abort Landing (TAL) sites in Zaragoza and Moron, Spain. On the 3rd attempt resulted in a successful launch at 7:49:47 on November 24th.

Project Assurance Engineering participated in the Lockheed Martin and Boeing Corporation midterm OSP presentations in Huntsville. Presentations reflected past performance, current status and future plans. It was evident that emphasis was placed on the design of an OSP on an expendable launch vehicle. Orbital Science Corporation and Northrop Grumman will make their midterm presentation this coming week, 12/10 - 12/12/02, also here in Huntsville. In addition, PAE will support a feasibility study for launching an OSP on an expendable launch vehicle, with emphasis on human ratings, vehicle trades and

crew survivability. This study, Crew Transfer and Rescue Vehicle (CTRV) 2, will be a continuation of the previous CTRV study that was highly complimented by NASA Administrator and Center Directors.

Project Assurance Engineering, representing QS10, participated in the Test Readiness Review on Dec. 3, 2002. The subject study is being conducted at Purdue University utilizing a setup consisting of the test stand structure, propellant feed systems, pressurization system, and the vacuum plenum chamber. Test objectives include: Verification of hypergolic ignition of 98% hydrogen peroxide and select Rocketdyne fuels, quantifying any ignition delay, measurement of combustion performance, and verification of hard-start experience with oxidizer lead ignition.

Project Assurance Engineering reviewed the test setup, propellant feed and pressurization systems to verify that any/all pressure vessels were capable of withstanding pressures expected during the test. In addition, S&MA confirmed through the Site Safety Manager that all safety equipment was in place, functioning properly, and access restricted to authorized personnel only. Propellant handling procedures were also reviewed and additional assurances provided that only trained and qualified personnel would perform loading operations using proper protective clothing, face shields/goggles and respirators.

Project Assurance Engineering participated in the Boeing Mid-term review for SLI, held 3-5 December 2002. Particular attention was paid to the safety, reliability, and maintainability presentations. Although, information was presented (appropriately) at a very high level, it appears that significant areas are being addressed in some fashion. It remains to be seen whether these disciplines will be embedded effectively and thoroughly in the design process.

Project Assurance Engineering supported QS20 as a team member during the NEQA conducted at United Space Alliance (USA) Assembly and Refurbishment Facility December 9 through 13, 2002. Team support involved the assessment of work and inspection instructions pertinent to several USA Process Review Team (PRT) activities. From those pre-designated activities, the team conducted on an "on the floor" assessment of the performance on a selection of three manufacturing processes. All findings were documented and presented to USA.

Project Assurance Engineering performed an Independent Assessment on RSRM / QS-20. The assessment evaluated S&MA methodology, approach and processes used to satisfy the CoFR requirements defined in the program requirement documents. RSRM Project Assurance Engineer coordinated the efforts in completing and documenting the assessment. RSRM S&MA successfully completed assessment with no major findings discovered by the IA assessment team.

Project Assurance Engineering participated in reviewing an anomaly that occurred during the GP-B Space Vehicle (SV) Thermal Vacuum (TVAC) test in LM building 156. The first cold-hot thermal cycle was completed and the 2nd cold cycle began. In response to request to get the Forward Equipment Enclosure (FEE) electronics "cold", an Electric Ground Support Equipment (EGSE) helium leak again increased raising pressure in the chamber. It was later decided to terminate the TVAC, remove the SV from the test chamber and repair the cause of the helium leak. PAE participated in the "Space Vehicle E28 Payload Test Readiness Review" (TRR) held at Stanford University (SU) on December 5. The review went quite well with a total of 18 action items assigned to LM and SU. The E28 test will begin at a date to be determined, depending upon SV TVAC progress.

SSME Project Assurance Engineering served as the focal point for the CoFR IA audit effort. The SSME response was coordinated with the entire SSME S&MA team, to ensure all areas were covered by the cognizant personnel, and the information recorded disseminated to the entire team for cross-training purposes. A data package was delivered to the auditors containing all the back-up material and action

items assigned during the audit have been pursued. The audit team was complimentary of our team effort, and the exercise will better prepare our team to cover all contingencies.

Shuttle Project Assurance Engineering supported the STS-107 PAR which was conducted via teleconference December 20, 2002. Discussion items presented by MSFC S&MA included the one presentation by Space Shuttle Main Engine(SSME) Assurance on STS-113 Main Engine #1 Nozzle Leak. Two presentations were made by Solid Rocket Booster (SRB) Assurance, SRB Amphenol Connector Pin Lack of Retention and SRB - BSM Paint Chip FOD. Both SRB issues are open issues and will be followed up at the Tag-up PAR. HEI coordinated presentation material, transmitted presentation material to HQ, provided electronic presentation of material and provided back up support during the review. SSME Project Assurance supported the STS-107 PAR by gathering information concerning the pertinent technical issues, and assisting in the preparation of the presentation materials. The two issues addressed by the SSME S&MA team included the fuel purge pressure rise and the Nozzle external leak observed on STS-113. The fuel purge pressure spike was written as a one-pager and accepted by the community as no constraint to the STS-107 mission, while the Nozzle leakage was pitched as a presentation and likewise found to be no constraint pending unexpected investigation findings.

Project Assurance Engineering participated in the Orbital Sciences/Northrup-Grumman Mid-term review for SLI, held 10-12 December 2002. Particular attention was paid to the safety, reliability, and maintainability presentations. Although information was presented (appropriately) at a moderately high level, it appears that significant areas are being addressed in a coordinated fashion. These disciplines appear to be embedded effectively and thoroughly in the design process. Northrup-Grumman is modeling their SLI approach on an apparently effective and successful reliability and maintainability program used on the B-2 program.

4.7 Risk Management and Risk Assessment

RA, at the request of S&MA leadership, presented a short seminar on applications for Statistical Process Control (SPC), outlining the basic tenets, benefits and possible applications of graphical statistical quality methods for NASA processes. The seminar described variability in sample data and how that variability can actually be used to best understand a process for the benefit of the experimenter, quality analyst, process owner or manager. Attendees gave positive feedback on this course and some requested that a longer and more in-depth course be given.

RA participated in a two day Code Q sponsored workshop on the Quantitative Risk Assessment System (QRAS) PRA software. Explanations of the features of QRAS were given as well as demonstrations of capabilities of the software for risk analysis followed up by hands-on examples. This workshop created an opportunity not only to learn the QRAS software but also to discuss, with representatives of other NASA centers, current topics and issues regarding risk assessment in the industry.

4.7.1 Risk Management

HEI continues to instruct projects at MSFC in Continuous Risk Management. HEI provided a two-hour overview of Continuous Risk Management to the ISTAR Project. Following the overview Project Assurance facilitated a risk identification and analysis workshop. There were 31 participants from the ISTAR project in attendance during the two days of instruction and the workshop activities. The workshop was very productive with the project identifying many new risks and also better defining the projects risk profile.

HEI participated in the Center Risk Management Capability to Perform Assessment as a member of the control team. The team is co-chaired by S&MA and SMO at MSFC. PA worked with the team to develop assessment criteria, and participated in the project interview process that will lead to an assessment of the centers capability to perform risk management. HEI hired a subcontractor to facilitate the assessment. The

results of the assessment process have been analyzed and summarized for center management and will be presented early in 2003.

PA continues researching tools and techniques for analyzing risk to provide additional value to the products provided to our customers and stakeholders. Particular emphasis has been placed on acquiring tools to better analyze risk associated with cost and schedule. An example of innovations in the future will be the use of Monte Carlo simulations in analyzing schedule and cost risks.

4.7.2 Space Shuttle Probabilistic Risk Assessment (PRA)

During this reporting period, Risk Assessment (RA) has been active in assisting each of the Shuttle element prime contractors in familiarizing their project management and S&MA personnel with their 2002 Probabilistic Risk Assessment (PRA) analysis and results. The Shuttle Program is expecting each project to support the results of their PRA analysis. This process should be complete by late January when the final results are due.

During this reporting period, RA continued to work on the Space Shuttle PRA project with each of the MSFC Prime Contractors. RA delivered a third iteration of the 2002 MSFC Shuttle Elements' provisional PRA models and risk probabilities to JSC on the scheduled due date. The models were delivered as fault trees in the SAPHIRE (Systems Analysis Program for Hands-On Integrated Reliability Evaluations) software and were used by JSC to perform model integration. RA worked with JSC to insure proper integration of the propulsion models with the Orbiter models. RA assisted the Shuttle Integration Office in starting their review of the MSFC element models. This assistance included forwarding a complete set of the current PRA models and data, along with brief descriptions about each of the models.

RA focused on the following PRA analysis areas during this reporting period. On the ET PRA effort, RA reconstructed the ET electrical interface models, performed data gathering and analysis, quantified models and completed an initial draft of the documentation. On the SRB PRA, RA continued to work closely with United Space Alliance (USA) in the modeling, database inputs and documentation. RA SRB work included reworking a large group of models to incorporate Bayesian updating on the mission-initiated risk contribution. On the SSME PRA, RA supported the SSME Project Office in their review of the SSME PRA models and worked with the SSME Project, Rocketdyne and Pratt & Whitney to resolve issues with High Pressure Turbopump and mission-initiated failure models. On the RSRM PRA, RA provided feedback about the submitted models and supported a meeting requested by TD-51 in their review of the RSRM model.

4.7.3 Reliability Prediction & Risk Analysis

During this reporting period, RA provided statistical expertise to the team investigating a leak in the joint between the Forward Exit Cone (FEC) and Aft Exit Cone (AEC) in the RSRM Nozzle designated for FSM-10. RA built independent 3D plots confirming warp away from the joint plane on both the FEC and AEC corresponding to the leak location.

For the ET undersized Intertank Stringers issue, RA assisted in analyzing the problem by performing independent statistical analysis and by assessing the contractor's calculations for statistical lower limits of Stringer thickness. It was found that Stringers in critical locations remain thick enough to maintain the required margin of safety; the type of Stringers with the significant thickness reduction are only used in locations with higher margins of safety. RA also assisted in the presentation of this issue at the ET FRR.

For the ET Bipod Strut foam loss issue, RA used statistical techniques to show how likely an occurrence this large was given history. Both classical and Bayesian methods were used to derive confidence limits.

RA was asked by the SRB project to determine whether a reinspection of stock Thrust Posts was sufficient to characterize all of the population. RA showed by illustration that using pass / fail data alone would not confirm that the population of thrust posts was acceptable.

RA also assisted in the SRB Booster Separation Motor (BSM) neoprene foreign object debris (FOD) issue. The investigation team found it highly likely that the neoprene was removed from the valve prior to manufacture of the current inventory of BSM motors. RA provided an additional numerical risk assessment at the request of S&MA to show that even if the neoprene had come off during the time current BSM inventory had been produced; damage to the shuttle would be highly unlikely.

RA has assisted in a SRB Thermal Protection System (TPS) process assessment at USA/ KSC. The team is working to improve process monitoring and assessment in their production facility. RA examined historical data to help determine which data might be useful and helped to ensure that the data are used to best advantage. RA also developed a control and acceptance charting computer application specifically for the TPS processes and tested it with real data

RA reviewed a Rocketdyne assessment of pad abort risk due to SSME Anti-Flood Valve sensor malfunction. RA agreed with the approach taken and assumptions made in the assessment. Possible changes to remove conservatism were also discussed during a review telecon with Rocketdyne.

4.7.4 SLI Risk Assessment

RA has assisted the Reliability, Maintainability and Supportability (RMS) team of the Second Generation Reusable Launch Vehicle (2GRLV) program in a refocusing effort to facilitate a paradigm shift in the program from technology models to system models. RA helped lay groundwork in redirecting the RMS team through 2003 and beyond, by schedule and task redefinitions of RMS efforts for the program. RA, with the 2GRLV RMS team, revised 2GRLV RMS data requirements for the 2GRLV contractors in support of this new systems approach to the Space Launch Initiative (SLI).

RA made comments to the 2GRLV PRA White Paper from NASA Code Q, as well as compiled others' comments in a coherent review of the white paper and presented the comments to the 2GRLV RMS team. RA did research on differences between the Northrop Grumman / Orbital Sciences Corporation (NG/OSC) reliability block diagram approach and the Flight-Oriented Integrated Reliability and Safety Tool (FIRST) approach in their respective analysis of the NG/OSC VFB-2 vehicle for a specific mission. RA examined the details behind the numbers for Loss of Crew (LOC), Loss of Vehicle (LOV) and Loss of Mission (LOM) and submitted organized charts explaining the results. RA traveled to SAIC in New York in efforts to learn more on how the FIRST software performs 2GRLV RMS analysis.

5.0 COST REDUCTION ITEMS

Our continuing cross-utilization of employees, continuous analysis of work in progress to assure that application of resources meets the needs of the task, and the judicious acquisition and distribution of tools to enhance the efficiency of all team members allow us to minimize cost to the customer.